SOFTWARE ENGINEERING

For the undergraduate curriculum in Software Engineering (http://www.se.iastate.edu) leading to the degree Bachelor of Science. This curriculum is accredited under the General Criteria and Software Engineering Program Criteria by the Engineering Accreditation Commission of ABET, http://www.abet.org.

This curriculum is jointly administered by the Department of Computer Science and the Department of Electrical and Computer Engineering at Iowa State University. The Software Engineering program provides undergraduate students with the opportunity to learn software engineering fundamentals, to study applications of state-of-the art software technologies and to prepare for the practice of software engineering. The student-faculty interaction necessary to realize this opportunity occurs within an environment motivated by the principle that excellence in undergraduate education is enhanced by an integrated commitment to successful, long-term research and outreach programs.

The software engineering curriculum offers emphasis areas in software engineering principles, process and practice. Students may also take elective courses in computer engineering and computer science.

Program Educational Objectives

Within five years of graduation, the graduates should:

1. attain a productive career in Software Engineering or related fields;
2. attain leadership roles and become effective collaborators to advance professional and organizational goals;
3. engage in continuous learning and professional development.

We expect that these objectives will be manifested in our graduates through the following five key attributes: (a) peer-recognized expertise, (b) engagement in professional practice, (c) sustained learning, (d) leadership and (e) teamwork.

Demonstration of expertise involves applying state-of-the-art practices for solving problems in the design, development, validation, evolution and sustainment of (software) products. Demonstration of professional engagement involves contributing locally and globally to the use of ethical, competent, and creative practices in industry, academia or the public sector. Demonstration of sustained learning involves the ability to adapt to rapid technological, environmental, and organizational changes through self-study and group study and through opportunities of professional development or graduate study. Demonstration of leadership involves the ability to take initiative, and to facilitate the advancements of individuals and the community by influencing others and by having a widespread, positive impact on critical issues and projects. Finally, demonstration of teamwork involves the ability to work with collaborators who have varied expertise, and with diverse cultural and interdisciplinary backgrounds.

As a complement to the instructional activity, the Department of Computer Science and the Department of Electrical and Computer Engineering provide opportunities for each student to have experience with broadening activities. Students have the opportunity to gain practical industry experience in the cooperative education and internship program. Students have the opportunity to participate in advanced research activities. Through international exchange programs, students learn about engineering practices in other parts of the world.

Curriculum in Software Engineering

Administered by the Department of Electrical and Computer Engineering in the College of Engineering and the Department of Computer Science in the College of Liberal Arts and Sciences.

Leading to the degree bachelor of science.

Total credits required: 125 cr. Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs. Note: Pass/Not Pass credits cannot be used to meet graduation requirements.

International Perspectives: 3 cr. 1
U.S. Diversity: 3 cr. 1
Communication Proficiency/Library requirement:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication (C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition (C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
<td>1</td>
</tr>
<tr>
<td>ENGL 309</td>
<td>Proposal and Report Writing (C or better in this course)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 314</td>
<td>Technical Communication (C or better in this course)</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credits 10

General Education Electives: 15 cr. 2

Total Credits 15

Basic Program: 27 cr.

A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Basic Program GPA). See Requirement for Entry into Professional Program in College of Engineering Overview section.

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
</thead>
<tbody>
<tr>
<td>CHEM 167</td>
<td>General Chemistry for Engineering Students</td>
<td>4</td>
</tr>
<tr>
<td>or CHEM 177</td>
<td>General Chemistry I</td>
<td></td>
</tr>
<tr>
<td>ENGL 150</td>
<td>Critical Thinking and Communication</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 250</td>
<td>Written, Oral, Visual, and Electronic Composition</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Orientation</td>
<td>R</td>
</tr>
<tr>
<td>or S E 101</td>
<td>Software Engineering Orientation</td>
<td></td>
</tr>
<tr>
<td>S E 185</td>
<td>Problem Solving in Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>LIB 160</td>
<td>Information Literacy</td>
<td>1</td>
</tr>
<tr>
<td>MATH 165</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 166</td>
<td>Calculus II</td>
<td>4</td>
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</tbody>
</table>
### Software Engineering Core: 34 cr.
A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Core GPA):

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>CPR E 281</td>
<td>4</td>
</tr>
<tr>
<td>COM S 327</td>
<td>3</td>
</tr>
<tr>
<td>CPR E 381</td>
<td>3</td>
</tr>
<tr>
<td>COM S 352</td>
<td>3</td>
</tr>
<tr>
<td>CPR E 308</td>
<td>3</td>
</tr>
<tr>
<td>COM S 230</td>
<td>3</td>
</tr>
<tr>
<td>CPR E 310</td>
<td>3</td>
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<tr>
<td>COM S 311</td>
<td>3</td>
</tr>
<tr>
<td>COM S 363</td>
<td>3</td>
</tr>
<tr>
<td>COM S 309</td>
<td>3</td>
</tr>
<tr>
<td>S E 319</td>
<td>3</td>
</tr>
<tr>
<td>S E 329</td>
<td>3</td>
</tr>
<tr>
<td>S E 339</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: CPR E 288, CPR E 381 and CPR E 308 are 4-credit courses. The core credit requirement (34 credits) is given in terms of 3-credit courses. If the 4-credit courses are taken instead, then the extra credits will be used as credits for Supplementary Electives.

### Math and Physical Science: 11 cr.

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>COM S 227</td>
<td>4</td>
</tr>
<tr>
<td>COM S 228</td>
<td>3</td>
</tr>
<tr>
<td>MATH 267</td>
<td>4</td>
</tr>
</tbody>
</table>

### Other Remaining Courses: 38 cr.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>S E 491</td>
<td>3</td>
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<tr>
<td>S E 492</td>
<td>2</td>
</tr>
<tr>
<td>SP CM 212</td>
<td>3</td>
</tr>
<tr>
<td>STAT 330</td>
<td>3</td>
</tr>
<tr>
<td>STAT 305</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 309</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 314</td>
<td>3</td>
</tr>
<tr>
<td>Math Elective</td>
<td>3</td>
</tr>
<tr>
<td>MATH 207</td>
<td>3</td>
</tr>
<tr>
<td>MATH 304</td>
<td>3</td>
</tr>
</tbody>
</table>

### Math Elective: Choose one from the following list

- MATH 267
- MATH 270
- MATH 304
- Combinatorics
- Probability and Statistics for Computer Science
- Engineering Statistics
- Proposal and Report Writing
- Technical Communication
- Matrices and Linear Algebra

### Total Credits

<table>
<thead>
<tr>
<th>Courses</th>
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</thead>
<tbody>
<tr>
<td>Total Credits</td>
<td>27</td>
</tr>
<tr>
<td>Software Engineering Core</td>
<td>11</td>
</tr>
<tr>
<td>Math and Physical Science</td>
<td>11</td>
</tr>
<tr>
<td>Other Remaining Courses</td>
<td>34</td>
</tr>
</tbody>
</table>
Supplementary Electives 3

17 12

Junior

Fall Credits Spring Credits
S E 3191 3 S E 329 3
COM S 230 or CPR E 3101 3 COM S 352 or CPR E 3083 3
COM S 3091 3 ENGL 314 3
COM S 321 or CPR E 3812, 3 3 SP CM 212 3
General Education Elective 3 COM S 3111 3
S E 339 3

15 18

Senior

Fall Credits Spring Credits
S E 494 0 S E 492 2
S E 491 3 Supplementary Electives 6
STAT 330 or 305 3 Software Engineering Electives 3
Technical Elective 3 General Education Elective 3
General Education Elective 3 Open Elective 3
Software Engineering Elective 3

15 17

Total Credits: 125

*Total credits required - 125 credits. Any transfer credit courses applied to the degree program require a grade of C or better (but will not be calculated into the ISU Cumulative GPA, Basic Program GPA or Core GPA). See also Basic Program and Special Programs.

Basic Program - A minimum GPA of 2.00 is required for this set of courses, including any transfer courses (please note that transfer course grades will not be calculated into the Basic Program GPA).

Must receive a C or better grade in required English classes.

General Educational Elective courses to be selected in consultation with SE advisers from a list of approved courses. They must include courses that satisfy university and college general education requirements. These courses include courses or categories of courses such as international perspectives and U.S. diversity, language, arts and humanities, and social sciences. Pass/Not Pass credit is not accepted.

Software Engineering Electives, Technical Electives, and Supplementary Electives must be selected from the program-approved list (https://www.se.iastate.edu/academics/resources).

1 Core Professional Curriculum (A minimum GPA of 2.00 is required for this set of courses, including any transfer courses but transfer course grades will not be calculated into the Core GPA).

2 Software Engineering students must have completed CPR E 281 and have obtained C or better in COM S 327 to enroll in COM S 321.

3 Students who take the 4-credit lab courses CPR E 288, CPR E 308, and CPR E 381 instead of the corresponding 3-credit alternatives can apply the additional credits towards Supplementary Electives. The total number of credits required in Software Engineering Program remains the same for all students.

Courses primarily for undergraduates:

S E 101: Software Engineering Orientation
Cr. R.
Introduction to the procedures, policies, and resources of Iowa State University and the department of Computer Science and Electrical and Computer Engineering. Information on engineering and computer-based professions.

S E 166: Careers in Software Engineering
Cr. R.
Overview of the nature and scope of the software engineering profession. Relationship of coursework to careers. Departmental rules, student services operations, degree requirements, program of study planning, career options, and student organizations.

S E 185: Problem Solving in Software Engineering
(2-2) Cr. 3.
Prereq: MATH 143 or satisfactory scores on mathematics placement examinations; credit or enrollment in MATH 165
Introduction to software engineering and computer programming. Systematic thinking process for problem solving in the context of software engineering. Group problem solving. Solving software engineering problems and presenting solutions through computer programs, written documents and oral presentations. Introduction to principles of programming, software design, and extensive practice in design, writing, running, debugging, and reasoning about programs.

S E 298: Cooperative Education
Cr. R. F.S.S.
Prereq: Permission of department and Career Services
First professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 319: Software Construction and User Interfaces
(Cross-listed with COM S). (3-0) Cr. 3.
Prereq: COM S 228

S E 329: Software Project Management
(Cross-listed with CPR E). (3-0) Cr. 3.
Prereq: COM S 309
S E 339: Software Architecture and Design
(Cross-listed with CPR E). (3-0) Cr. 3.
Prereq: S E 319

S E 342: Principles of Programming Languages
(Cross-listed with COM S). (3-1) Cr. 3. F.S.
Prereq: Minimum of C- in COM S 228, COM S 230 or CPR E 310
Study of concepts in programming languages and major programming paradigms, especially functional programming. Special emphasis on design tradeoffs that enable students to make sound choices of programming languages for a given software development task. Programming projects.

S E 396: Summer Internship
Cr. R. Repeatable. SS.
Prereq: Permission of department and Career Services
Summer professional work period.

S E 397: Software Engineering Internship
Cr. R. Repeatable. F.S.
Prereq: Permission of department and Career Services
One semester maximum per academic year professional work period.

S E 398: Cooperative Education
Cr. R. F.S.SS.
Prereq: S E 298, permission of department and Career Services
Second professional work period in the cooperative education program. Students must register for this course before commencing work.

S E 409: Software Requirements Engineering
(Cross-listed with COM S). (3-0) Cr. 3. F.
Prereq: COM S 309
The requirements engineering process including identification of stakeholders requirements elicitation techniques such as interviews and prototyping, analysis fundamentals, requirements specification, and validation. Use of Models: State-oriented, Function-oriented, and Object-oriented. Documentation for Software Requirements. Informal, semi-formal, and formal representations. Structural, informational, and behavioral requirements. Non-functional requirements. Use of requirements repositories to manage and track requirements through the life cycle. Case studies, software projects, written reports, and oral presentations will be required.

S E 412: Formal Methods in Software Engineering
(Cross-listed with COM S, CPR E). (3-0) Cr. 3. S.
Prereq: COM S 230 or CPR E 310; COM S 311, STAT 330
A study of formal techniques for model-based specification and verification of software systems. Topics include logics, formalisms, graph theory, numerical computations, algorithms and tools for automatic analysis of systems. Graduate credit requires in-depth study of concepts.

S E 416: Software Evolution and Maintenance
(Cross-listed with CPR E). (3-0) Cr. 3.
Prereq: COM S 309
Practical importance of software evolution and maintenance, systematic defect analysis and debugging techniques, tracing and understanding large software, impact analysis, program migration and transformation, refactoring, tools for software evolution and maintenance, experimental studies and quantitative measurements of software evolution. Written reports and oral presentation.

S E 417: Software Testing
(Cross-listed with COM S). (3-0) Cr. 3. S.
Prereq: COM S 309; COM S 230 or CPR E 310; ENGL 250, SP CM 212
Comprehensive study of software testing, principles, methodologies, management strategies and techniques. Test models, test design techniques (black box and white box testing techniques), test adequacy criteria, integration, regression, system testing methods, and software testing tools.

S E 419: Software Tools for Large Scale Data Analysis
(Cross-listed with CPR E). (3-3) Cr. 4.
Prereq: CPR E 308 or COM S 352, COM S 309
Software tools for managing and manipulating large volumes of data, external memory processing, large scale parallelism, and stream processing, data interchange formats. Weekly programming labs that involve the use of a parallel computing cluster.

S E 490: Independent Study
Cr. arr. Repeatable.
Prereq: Senior classification in software engineering
Investigation of an approved topic.

S E 491: Senior Design Project I and Professionalism
(2-3) Cr. 3.
Prereq: S E 329, completion of 29 credits in the S E core professional program, ENGL 314
Preparing for entry to the workplace. Selected professional topics. Use of technical writing skills in developing project plan and design report; project poster. First of two-semester team-oriented, project design and implementation experience.

S E 492: Senior Design Project II
(1-3) Cr. 2.
Prereq: S E 491
Second semester of a team design project experience. Emphasis on the successful implementation and demonstration of the design completed in S E 491 and the evaluation of project results. Technical writing of final project report; oral presentation of project achievements.

S E 494: Software Engineering Portfolio Development
Cr. R. F.S.
Prereq: Credit or enrollment in S E 491
Portfolio assessment for Software Engineers. Guidelines and Advice to improve software engineering portfolios and to better use portfolios as a tool to enhance career opportunities.

S E 498: Cooperative Education
Cr. R. Repeatable. F.S.SS.
Prereq: S E 398, permission of department and Career Services
Third and subsequent professional work periods in the cooperative education program. Students must register for this course before commencing work.